# APPLICATION UNDER UNITED STATES PATENT LAWS

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Invention:   OPTICAL DISK APPARATUS AND OPTICAL DISK PROCESSING METHOD

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## This is a:

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# SPECIFICATION

TITLE OF THE INVENTION

OPTICAL DISK APPARATUS AND OPTICAL DISK PROCESSING
METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

5      This application is based upon and claims the
benefit of priority from prior Japanese Patent
Application No. 2003-161039, filed June 5, 2003, the
entire contents of which are incorporated herein by
reference.

10              BACKGROUND OF THE INVENTION

1.   Field of the Invention

The present invention relates to an optical disk
apparatus, particularly to an optical disk recording
and reproducing apparatus and an optical disk

15   processing method, which perform double-speed readout
on the basis of management information (for example,
navigation pack).

2.   Description of the Related Art

In recent years, the optical disk apparatus is

20   improved and the optical disk apparatus becomes
widespread.  Even in technologies of this field, the
higher-level technology is demanded.  One of the
demanded technologies of the filed is to perform
smoothly reproduction, even in processing of reading

25   out and reproducing contents of an optical disk not at
one double speed but at high double speed.  Utilization
of a buffer memory is required for the reproduction of

the contents at high speed.

In the prior art (Jpn. Pat. Appln. KOKAI Publication No. 2000-101970) concerned with the reproduction of the contents at high speed, there is disclosed a reproducing apparatus and reproducing method in which the backward reproduction is performed by utilizing the buffer memory. In Jpn. Pat. Appln. KOKAI Publication No. 2000-101970, data which has been read out from the optical disk and reproduced is stored in the buffer memory, and the data is properly read out from the buffer memory when the backward reproduction is required.

In the prior art, it is shown that the buffer memory is utilized in the case of the special reproduction. However, no specific solution is given to the following problem of the invention shown below.

That is, in the optical disk apparatus according to the invention, although contents information is read in each chapter in the buffer memory, all pieces of the contents information are not read in the buffer memory. For example, in the case of four double speed or eight double speed, the contents information is captured in the buffer memory in each reproducing unit (for example, VOBU (Video Object Unit)) of an address indicating management information such as navigation pack (NV_PCK). Even in the contents information which has read at one double speed, the contents information

which is not read at four double speed is present.

The processing of reproducing the contents
information is divided into capture processing which
captures the contents information in the buffer by
using a read buffer, a fore-control unit, and the like,
and then the processing which reads out the contents
information from the read buffer to encode the contents
information by using the stream control unit and the
like included in the encoder and the like.  In the
stream control unit, for example, when an end point of
the contents information in one chapter is detected, an
end position of one chapter is informed to the fore-
control unit again.  According to the information of
the end position of one chapter, the fore-control unit
resumes the readout of the contents information of the
next chapter.

Thus, since the step of capturing the contents
information in the fore-control unit and the step
of encoding the contents information in the stream
control unit of the post-control unit are performed at
different timing, the following problem is generated by
the user operation in the case where the reproducing
speed is changed from the eight double speed to the one
double speed in readout processing.

That is, even in the case where the reproducing
speed is changed from the eight double speed to the one
double speed in detecting the end position of the

contents information in the stream control unit of the post-control unit, the contents information given from the read buffer becomes previous one which is read at the eight double speed. Therefore, while the stream control unit currently recognizes the reproducing speed as the one double speed, the stream control unit detects the end point of the contents information for the contents information which is read at eight double speed and fails the detection of the end point.

In order to avoid the above problem, it is necessary to restrict the processing such that the read operation of the next chapter is not performed until all the read buffers become empty when the reproducing speed is changed. However, since the restriction of the processing leads to decreases in the read speed and the reproducing speed, when the reproducing speed is changed during the reproduction, there is the problem that sufficient processing speed can not be obtained.

## BRIEF SUMMARY OF THE INVENTION

According to an aspect of the invention, there is provided an optical disk apparatus comprising a detection unit which detects one information unit in one of a plurality of areas from an optical disk which stores the plurality of information units including management information and contents information corresponding to the management information in the plurality of areas, a reading unit which stores the

information unit including the management information
and the contents information in a buffer and performs
control in order to read the information unit from the
buffer at predetermined timing, and a reproducing unit

5     which decodes and reproduces the contents information
read out from the buffer by control of the reading
unit.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a block diagram showing a configuration

10    of an optical disk apparatus which is of an embodiment
of the invention;

FIG. 2 is an explanatory view for explaining read
operation of the optical disk apparatus which is of an
embodiment of the invention;

15    FIG. 3 is a view showing one of examples of
management information treated by the optical disk
apparatus which is of an embodiment of the invention;

FIG. 4 is a flow chart showing one of processing
operations of a fore-control unit which is of the

20    optical disk apparatus according to a first embodiment
of the invention;

FIG. 5 is a flow chart showing one of processing
operations of a post-control unit which is of the
optical disk apparatus according to the first

25    embodiment of the invention;

FIG. 6 is a flow chart showing one of processing
operations of the fore-control unit which is of the

optical disk apparatus according to a second embodiment
of the invention;

FIG. 7 is a flow chart showing one of processing
operations of the post-control unit which is of

5    the optical disk apparatus according to the second
embodiment of the invention;

FIG. 8 is a flow chart showing one of processing
operations of the fore-control unit which is of the
optical disk apparatus according to a third embodiment

10   of the invention; and

FIG. 9 is a flow chart showing one of processing
operations of the post-control unit which is of the
optical disk apparatus according to the third
embodiment of the invention.

15         DETAILED DESCRIPTION OF THE INVENTION

Referring to the accompanying drawings, the
optical disk apparatus which is of an embodiment of the
invention will be described in detail below.   FIG. 1 is
a block diagram showing a configuration of the optical

20   disk apparatus which is of an embodiment of the
invention, FIG. 2 is an explanatory view for explaining
read operation, and FIG. 3 shows one of examples of
management information treated by the optical disk
apparatus which is of an embodiment of the invention.

25   [Optical Disk Apparatus according to the Invention]
(Basic Configuration and Operation)

In FIG. 1, an optical disk apparatus A which is of

an embodiment of the invention includes a ROM and a RAM
60 which are a storage area and a control unit 61 which
controls overall operation and the like. The optical
disk apparatus A also includes a rotary motor M which
5    rotates an optical disk D at predetermined number of
revolutions and a servo control unit 52. Further, the
optical disk apparatus A includes a pickup head PUH
which writes information in the optical disk D and
reads out the information from the optical disk D.
10   The pickup head PUH includes an objective lens L, a
photodetector PD such as a four-channel photodetector
and a laser diode LD which emits a laser beam, and head
amplifier.

The servo control unit 52 is connected to
15   processing circuits of servo control system 55. The
processing circuits of servo control system 55 include
an objective lens guiding circuit, a focus control
circuit, an objective lens driving signal switch, an
objective lens driving circuit, a wobble (WB) signal
20   detector and the like, which are not shown. The
processing circuits of servo control system 55 perform
focus retracting operation and the like.

The optical disk apparatus A also includes a
signal processing unit 56 to which a detection signal
25   is supplied from the photodetector PD of the pickup
head PUH and a read buffer 57 which perform modulating/
demodulating processing or ECC processing to a signal

to be recorded which is given from the outside or the
detection signal detected by the pickup head PUH.  The
data processing unit 58 is connected to a RAM 59 which
provides a working area and an interface (I/F) 65 which
exchanges the signal between the optical disk apparatus
A and an external device.

In the above configuration, the control unit 61
uses the RAM 60 as the working area and performs
the predetermined operation according to a program
including the invention which is recorded in the RAM
60.  The optical disk D is irradiated with a light beam
output from the pickup head PUH.  The reflected light
beam from the optical disk D is converted into an
electric signal by the head amplifier.  The electric
signal is stored in the read buffer 57 through the
data processing unit 56, and then input to the data
processing unit 58.

The objective lens guiding circuit, the focus
control circuit, the objective lens driving signal
switch, the objective lens driving circuit, the wobble
(WB) signal detector, and the like, which are not shown
and are includes in the processing circuits of servo
control system 55, perform the focus retracting
operation and the like.

In data writing operation, by using a write clock
generated by a write channel circuit (not shown), the
data processing unit 58 adds an error detection code

(EDC) and an ID to the data transmitted through the I/F 25, performs data scramble processing to the data in order to stabilize the servo, adds an error correction code (ECC) to the data, and adds a synchronizing signal

5    to the data.  Further, the data processing unit 58 modulates the signals except the synchronizing signal and transmits the signals except the synchronizing signal to a write power control unit 63.  The signals except the synchronizing signal are written in the

10   optical disk D through a laser diode driving circuit 64 by optimum write strategy for the corresponding medium.

In data readout operation, the detection signal from the pickup head PUH is amplified by the signal processing unit 56 and transmitted to the read buffer

15   57 through an optimum equalizer.  Channel data is read in the read buffer 57 with a readout clock generated by a PLL circuit (not shown).  In the data which has been read, synchronized symbol data is read out by the data processing unit 58.  Then, error correction processing

20   and disk scramble processing are performed, and the data is transferred to the external device or the like through the I/F 65.

In the optical disk apparatus having the above basic structure and basic function, the processing of

25   obtaining and reproducing the stored information in the case of a change in the reproducing speed during the reproducing processing, which is of the embodiment of

the invention is considered, will be described in
detail by using the flow chart.

[Optical Disk Apparatus according to First Embodiment]

A first embodiment is the optical disk apparatus
and the optical disk processing method in which the
fore-control unit writes the next search address in
management information such as NV_PCK and the post-
control unit detects absence of the search address in
the management information and decides an end of a
chapter to transfer to capture of the next chapter.

(Reason for Processing Delay)

The optical disk apparatus according to the
embodiment of the invention is one which shows a
procedure of performing smoothly capture processing of
contents information.  In the optical disk apparatus,
the contents information is read in the buffer memory
in each chapter.  However, in the case of high double-
speed, all pieces of the contents information are not
read.

FIG. 2 shows a state in which the optical disk
apparatus A reads some of VOBUs in a plurality of VOBUs
from VOBU_A to VOBU_P into the read buffer 57 while
other VOBUs are properly skipped by high-speed readout.
The capture processing into the read buffer 57 is
performed by the control unit 61 which is of the fore-
control unit shown in FIG. 1, and the processing of
deciding the final VOBU in the chapter is performed by

the stream control unit 62 which is of the post-control unit.

FIG. 3 shows address information in each VOBU. As shown in FIG. 2, the address information is included in a navigation pack (NV_PCK) NP which is of the management information arranged in a front end of each VOBU. For example, in the address information of VOBU_A, FIG. 3 shows that the address of VOBU_A is 1000, the address of the next VOBU is 2000 in the case where the reproduction is performed in one double speed, the address of the second next VOBU is 3000 in the case where the reproduction is performed in four double speed, and the address of the next VOBU is 5000 in the case where the reproduction is performed in eight double speed.

As shown in FIG. 2 and FIG. 3, when the double speed is initially selected, as shown in the address information of VOBU_A shown in FIG. 3, it is known that the next VOBU is VOBU_B having the address of 2000 which is the search address of X1. When the four double speed is selected next in VOBU_B, VOBU_D having the address of 4000 which is of the search address of X4 is selected. Then, VOBU_F is selected in the same way. When the eight double speed is selected next in VOBU_J, VOBU_N having the address of 10000 which is of the search address of X8 is selected. Then, VOBU_N is selected in the same way. Under control of the control

unit 61 which is of the fore-control unit, these VOBUs
are read by the action of the pickup head PUH and
stored in the read buffer 57.

The processing of reproducing the contents
information is mainly divided into tow steps, i.e.
the capture processing which captures the contents
information in the buffer by using the read buffer,
the fore-control unit, and the like, and then the
processing which reads out the contents information
from the read buffer to encode the contents information
by using the stream control unit and the like included
in the encoder and the like.  In the stream control
unit 62, for example, when an end point of the contents
information in one chapter is detected, an end position
of one chapter is informed to the fore-control unit 61.
According to the information of the end position of one
chapter, the fore-control unit 61 resumes the readout
of the contents information of the next chapter.

Thus, since the step of capturing the contents
information in the fore-control unit and the step of
encoding the contents information in the stream control
unit of the post-control unit are performed at
different timing, the following problem is generated by
the user operation in the case where the reproducing
speed is changed from the eight double speed to the one
double speed in readout processing.

That is, even in the case where the reproducing

speed is changed from the eight double speed to the one
double speed in detecting the end position of the
contents information in the stream control unit of the
post-control unit, the contents information given from
5      the read buffer becomes previous one which is read at
the eight double speed.  Therefore, while the stream
control unit 62 currently recognizes the reproducing
speed as the one double speed, the stream control unit
62 detects the end points of the contents information
10     for the contents information which is read at eight
double speed and fails the detection of the end point.

In order to avoid the above problem, it is
necessary to restrict the processing such that the read
operation of the next chapter is not performed until
15     all the read buffers become empty when the reproducing
speed is changed (or even if the reproducing speed is
not changed).  However, since the restriction of the
processing leads to decreases in the read speed and the
reproducing speed, delay of the reproducing processing
20     occurs or the reproduction is not smoothly performed.

As described below, the first embodiment is one in
which the fore-control unit writes the next search
address in management information such as NV_PCK and
the post-control unit detects absence of the search
25     address in the management information and decides an
end of a chapter to transfer to capture of the next
chapter.  Accordingly, since it is not necessary to

capture the contents information after the read buffers become empty in each chapter, the read processing and reproducing processing can be smoothly performed at high speed.

5 (Specific Processing Method)

FIG. 4 is the flow chart showing one of processing operations of the fore-control unit which is of the optical disk apparatus according to the first embodiment of the invention, and FIG. 5 is the flow chart 10 showing one of processing operations of the post-control unit.

In the flow chart shown in FIG. 4, when reproducing direction is received, the reflected light beam of the laser beam emitted from the pickup head PUH is 15 received with the photodetector PD under the control of the control unit 61 of the fore-control unit, the detection signal according to the reflected light beam received with the photodetector PD is processed by the signal processing unit and the like through the head 20 amplifier, and then the initial VOBU is supplied to the read buffer. As described later in a third embodiment, it is preferable to obtain the address information (address of the contents information of one chapter) which is of chapter management information in each 25 chapter. When NV_PCK of the initial VOBU is detected (S11), NV_PCK of the initial VOBU is captured in the RAM 60 of the working memory or the like (S12), and the

address of VOBU to be searched next according to the
current reproducing speed (one double speed, four
double speed, eight double speed, and the like) is read
from the address information in NV_PCK (S13).

5    At this point, when the eight double speed is
selected, as shown in FIG. 3, the address of "5000" is
additionally written in a reserve area of the address
information as the search address (S14). Then, VOBU_E
indicated by "5000" of the search address is detected.

10   The processing operation returns to step S11 as long as
the search address is continued, and the processing is
repeated until the contents information in the chapter
is completely captured.

When the search address becomes lost, in step S14,

15   absence of the search address is written in the reserve
area, and it is preferable that data of "FF" is written
in the reserve area. Accordingly, when the search
address becomes lost, the processing is in a standby
state for waiting a read start direction from the

20   stream control unit 62 of the post-control unit.

In the flow chart shown in FIG. 5, the stream
control unit 62 of the post-control unit sequentially
reads VOBU stored in the read buffer 57 and performs
the control of the reproducing processing such as

25   encode processing. At the same time, the stream
control unit 62 decides whether VOBU is the end of the
chapter or not. When the stream control unit 62

decides that VOBU is the end of the chapter, the stream
control unit 62 gives the read start direction of the
next chapter to the control unit 61 of the fore-control
unit.

5 When NV_PCK is detected (S21), the search address
which is of an additional address is read out from the
reserve area of the address information in NV_PCK
(S22). At this point, when the usual address is
present, since it is not an end position, the process-

10 ing operation returns to step S21 and the stream
control unit 62 continues the processing of the next
VOBU. When the state in which the address is absent is
detected, e.g. when a value such as the above address
of "FF" (any information to indicate the end position)

15 is detected (S23), the stream control unit 62 decides
that the chapter is ended and gives the start direction
to the fore-control unit 61 so that the fore-control
unit 61 starts to capture the next chapter (S24). The
processing is continued until, e.g. a title end is

20 detected (S25).

The search address is managed by utilizing the
reserve area of the address information of NV_PCK with
the fore-control unit 61 and the post-control unit 62.
As a result, even if a user changes the reproducing

25 speed through the reproduction, the post-control unit
62 never fails recognition of the end position, so that
it is not necessary to take measures such that the read

buffer 57 empty in each chapter.   Therefore, the
reproducing processing can be very smoothly performed.
[Optical Disk Apparatus according to Second Embodiment]

A second embodiment is the optical disk apparatus

5      and the optical disk processing method in which the
fore-control unit writes reproducing magnification
during capturing the contents information in the
management information such as NV_PCK and the post-
control unit searches the search address from NV_PCK in

10     accordance with the reproducing magnification during
capturing the contents information, detects absence of
the search address in the management information, and
decides the end of the chapter to transfer to the
capture of the next chapter.

15     FIG. 6 is the flow chart showing one of processing
operations of the fore-control unit which is of
the optical disk apparatus according to the second
embodiment of the invention, and FIG. 7 is the flow
chart showing one of processing operations of the post-

20     control unit.

In the flow chart shown in FIG. 6, when the
reproducing direction is received, the reflected light
beam of the laser beam emitted from the pickup head PUH
is received with the photodetector PD under the control

25     of the control unit 61 of the fore-control unit, the
detection signal according to the reflected light beam
received with the photodetector PD is processed by the

signal processing unit 56 and the like through the head
amplifier, and then the initial VOBU is supplied to
the read buffer. When NV_PCK of the initial VOBU is
detected (S31), NV_PCK of the initial VOBU is captured
5   in the RAM 60 of the working memory or the like (S32),
and the address of VOBU to be searched next according
to the current reproducing speed (one double speed,
four double speed, eight double speed, and the like) is
read from the address information in NV_PCK (S33).

10  At this point, when the eight double speed is
selected, as shown in FIG. 3, the eight double speed,
e.g. "8" is additionally written in the reserve area of
the address information (S34). Then, VOBU_E indicated
by "5000" of the search address is detected. The
15  processing operation returns to step S11 as long as the
search address is continued, and the processing is
repeated until the contents information in the chapter
is completely captured. When the search address
becomes lost, the processing is in the standby state
20  for waiting the read start direction from the stream
control unit 62 of the post-control unit.

In the flow chart shown in FIG. 7, the stream
control unit 62 of the post-control unit sequentially
reads VOBU stored in the read buffer 57 and performs
25  the control of the reproducing processing such as
encode processing. At the same time, the stream
control unit 62 decides whether VOBU is the end of the

chapter or not. When the stream control unit 62
decides that VOBU is the end of the chapter, the stream
control unit 62 gives the read start direction of the
next chapter to the control unit 61 of the fore-control

5   unit.

When NV_PCK is detected (S41), the reproducing
magnification during capturing the contents information
is read out from the reserve area of the address
information in NV_PCK (S42). The address according to

10  the reproducing magnification is obtained from the
address information in NV_PCK shown in FIG. 3 (S43).
At this point, when the usual address is present, since
it is not an end position, the processing operation
returns to step S41 and the stream control unit 62

15  continues the processing of the next VOBU. When the
state in which the address is absent is detected, e.g.
when the value such as the above address of "FF" (any
information to indicate the end position) is detected
(S44), the stream control unit 62 decides that the

20  chapter is ended and gives the start direction to the
fore-control unit 61 so that the fore-control unit 61
starts to capture the next chapter (S45). The
processing is continued until, e.g. the title end is
detected (S46).

25  The reproducing magnification during capturing
the contents information is managed by utilizing the
reserve area of the address information of NV_PCK with

the fore-control unit 61 and the post-control unit 62.
As a result, even if the user changes the reproducing
speed through the reproduction, the post-control unit
62 never fails recognition of the end position, so
5    that it is not necessary to take measures such that the
read buffer 57 empty in each chapter.  Accordingly,
similarly to the first embodiment, even in the second
embodiment, the problem that the reproduced image is
frozen can be eliminated and the reproducing processing
10   can be very smoothly performed.

[Optical Disk Apparatus according to Third Embodiment]

A third embodiment is the optical disk apparatus
and the optical disk processing method in which the
fore-control unit additionally writes the final
15   contents information (VOBU) of the chapter in a back
end of the image of the chapter in accordance with the
management information such as NV_PCK and the post-
control unit decides the end of the chapter to transfer
to the capture of the next chapter when the post-
20   control unit monitors the address of the one double
speed of NV_PCK and the like to detect the final image.

FIG. 8 is the flow chart showing one of processing
operations of the fore-control unit which is of the
optical disk apparatus according to the third
25   embodiment of the invention, and FIG. 9 is the flow
chart showing one of processing operations of the post-
control unit.

In the flow chart shown in FIG. 8, when the reproducing direction is received, the reflected light beam of the laser beam emitted from the pickup head PUH is received with the photodetector PD under the control

5  of the control unit 61 of the fore-control unit, the detection signal according to the reflected light beam received with the photodetector PD is processed by the signal processing unit 56 and the like through the head amplifier, and then the initial VOBU is supplied to the

10  read buffer. At this point, the address information (address of the contents information of one chapter) which is of the chapter management information in each chapter is obtained. When NV_PCK of the initial VOBU is detected (S51), NV_PCK of the initial VOBU is

15  captured in the RAM 60 of the working memory or the like (S52), and the address of VOBU to be searched next according to the current reproducing speed (one double speed, four double speed, eight double speed, and the like) is read from the address information in NV_PCK

20  (S53).

Then, VOBU_E indicated by "5000" of the search address is detected. The processing operation returns to step S11 as long as the search address is continued, and the processing is repeated until the contents

25  information in the chapter is completely captured (S54).

When the search address becomes "nothing", the

final contents information (VOBU) of the chapter, i.e.
the contents information of VOBU_P shown in FIG. 3 is
obtained by the chapter management information in each
chapter, which has been initially obtained, and the

5      contents information of VOBU_P is added to the back end
of the contents information which has already been
obtained (S55).   Then, the processing is in the standby
state for waiting the read start direction from the
stream control unit 62 of the post-control unit.

10         In the flow chart shown in FIG. 9, the stream
control unit 62 of the post-control unit sequentially
reads VOBU stored in the read buffer 57 and performs
the control of the reproducing processing such as
encode processing.   At the same time, the stream

15     control unit 62 decides whether VOBU is the end of
the chapter or not.   When the stream control unit 62
decides that VOBU is the end of the chapter, the stream
control unit 62 gives the read start direction of the
next chapter to the control unit 61 of the fore-control

20     unit.

When NV_PCK is detected (S61), the address
information corresponding to the one double speed of
the address information in NV_PCK is obtained (S62).
When the address corresponding to the one double speed

25     is the usual address, since it is not the end position,
the processing operation returns to step S61 and the
stream control unit 62 continues the processing of the

next VOBU. When the state in which the address is
absent is detected, e.g. when the value such as the
above address of "FF" (any information to indicate the
end position) is detected (S63), the stream control

5      unit 62 decides that the chapter is ended and gives the
start direction to the fore-control unit 61 so that the
fore-control unit 61 starts to capture the next chapter
(S64). The processing is continued until, e.g. the
title end is detected (S65).

10     The fore-control unit 61 adds the contents
information of the final VOBU of the chapter to the
back end of the read information and the post-control
unit 62 continues to monitor "nothing" of search
address of the address information of the one double

15     speed in NV_PCK. As a result, even if the user changes
the reproducing speed through the reproduction, the
post-control unit 62 never fails recognition of the end
position, so that it is not necessary to take measures
such that the read buffer 57 empty in each chapter.

20     Accordingly, similarly to the first and second
embodiments, the problem that the reproduced image is
frozen can be eliminated and the reproducing processing
can be very smoothly performed.

Those skilled in the art could realize the

25     invention by the various embodiments described above.
Further, various modifications of the embodiments could
be easily conceived by those skilled in the art, and

the invention could be applied to various embodiments without any inventive ability.  Therefore, it is to be understood that the invention covers the broad scope which is consistent with the disclosed principle and the novel feature and the invention is not limited to the above-described embodiments.

As described in detail above, the invention uses the method in which the management of the search address is performed in the reserve area of the management information such as NV_PCK by the fore-control unit and the post-control unit.  As a result, even in the case where the reproducing speed is changed during the reproduction, the end position is always correctly decided, and it is not necessary to take measures such that the read buffer 57 becomes empty in each chapter, so that the optical disk apparatus and the optical disk processing method in which the reproducing processing is smoothly performed can be provided.